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STATEMENT

ON

SUPERCONDUCTIVITY

BY

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DEPUTY UNDER SECRETARY OF DEFENSE

FOR RESEARCH AND ADVANCED TECHNOLOGY

TO

THE SUBCOMMITTEE ON TRANSPORTATION, AVIATION, AND MATERIALS

AND

THE SUBCOMMITTEE ON SCIENCE, RESEARCH, AND TECHNOLOGY

OF THE

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

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Mr. Chairman and Members of the Joint Subcommittees

I am Ronald L. Kerber, Deputy Under Secretary of Defense for Research and Advanced Technology. I appreciate the opportunity to appear before you to discuss Department of Defense superconductivity activity.

I have a brief prepared statement I would like to present to the Joint Subcommittees.

Recent advances in high temperature superconductivity offer the Department of Defense opportunities for enhancing our national security through expansion of capabilities of existing weapons and support systems, and through development of new generations of systems yet to be conceived. It is possible that military systems with superconducting features will constitute a key area of future technological competition with our adversaries. While it is difficult to foresee the full national security implications of superconductivity given the knowledge at hand, the Department should and will devote substantial resources to this new, dynamic, and important technology. In accord with the President's superconductivity initiative, the Department plans to spend $150 million on superconductivity R&D over the next three years. We intend to accommodate this level of effort within the President's budget. superconductors, (Nippon) ←

Taking advantage of the opportunities, and meeting the challenges posed by superconductivity will require judicious, yet imaginative, planning. Equally important will be a high level of collaboration with industry, other federal research agencies, and the university community. Inasmuch as defense technologies have historically evolved from an industry-university-DoD base, the Department is already well positioned to capitalize on this technical opportunity.

The Department has a long and productive history of support for superconductivity R&D, and indeed was the first among the federal agencies to fund superconductivity research at a significant level. Beginning in the 1940's the primary applications on the horizon were infra-red detectors, first-generation computer switches, and magnetic suspension gyroscopes. More recently, DoD has pioneered the development of Josephson junction technology for wide band detection and processing of weak magnetic and electromagnetic signals. This technology has important military applications in surveillance systems. Moreover, aspects of this technology have been transferred to the civil sector in such diverse fields as medical diagnosis and geological exploration.

I would now like to return to the challenge and opportunities superconductivity poses for our national security, and to the response the Department has made in recent months. We have endeavored expeditiously to develop superconductivity technology

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with a judicious combination of R&D, applications assessments, and fabrication methods.

We have already completed the first phase of planning for a five-year Defense superconductivity program. Its goal is to ensure that the revolutionary potential of superconductivity is utilized as soon as possible for military applications, while simultaneously transferring appropriate aspects of the technology to the civil sector in a timely and efficient manner. The program is designed to integrate the scientific and technical capabilities of industry, academia, and other federal agencies, with DoD technical efforts. Plans call for the Services, the Defense Advanced Research Projects Agency, the Strategic Defense Initiative Organization, and other Defense components to play major roles in the execution of the program.

This program will encompass activities extending from basic research, through exploratory development, to demonstration. Contracts will be awarded for single investigator projects, multi-investigator interdisciplinary activities, and multi-organizational collaborations among university, government, and industry scientists and engineers. In addition, the Department will profit from the active superconductivity programs being pursued by DoE, NSF, DoC and NASA. Close collaboration with these efforts is already in effect and will increase as the field matures. The monitoring of foreign developments is being facilitated by DoD liaison activities in Europe and the Far East.

Included within the scope of the program are basic characterizations of known superconducting materials, searches for still higher temperature superconductors, approaches to the processing of planar structures (films) and bulk materials (wires, cables, rods, etc.). In addition, it includes the exploitation of small-scale applications (sensors, superconducting electronics, hybrid superconducting-semiconducting electronics), and the science and technology base underlying large-scale applications (magnets, motors, generators, electromagnetic launchers, and directed energy systems).

Much of our program is focused in directions of greatest impact on DoD systems. Considerations of special concern to DoD include weight, volume, resistance to thermal and mechanical shock, and radiation hardness. These and other performance and materials properties requirements mandate a DoD-specific research, development and demonstration program which is in the process of being implemented.

such areas as

Materials research is oriented toward such DoD-specific applications ~~as~~ sensors, ultra-high-speed signal processors and memories, ~~and~~ high-current-density conductors for electric motors and generators, for energy storage, for electromagnetic launchers, and ~~for~~ high power radar transmitter tubes. Processing activities encompass studies of precursor materials, densification, deposition, crystal growth, etc. Underlying science investigations address crystal chemistry, compositional phase

equilibria, optimum routes to materials synthesis, and materials compatability. Methods and mechanisms for producing materials of the desired composition, structure, defect state, surface state, and with properties required for use in conjunction with non-superconducting materials, are emphasized. These processing activities are closely coordinated with those of other agencies and industry, but, as noted previously, are focused on requirements unique to DoD.

Large scale applications include compact high-energy-density electric motors and generators, magnets and magnetic energy storage systems, pulsed electrical power systems, compact accelerators, free electron lasers, particle beam systems, gyrotron magnets, and electromagnetic guns. Experience has shown that nearly every such magnet-type application requires its own custom designed and fabricated superconducting winding materials and winding configuration. Thus our program plans call for significant efforts in the science and technology of high-current-density, high-magnetic-field superconducting wires, cables, and bars. Because the Department of Energy is highly accomplished in this area our efforts are being closely coordinated. It is our view that programs of this type are well coordinated at staff and action officer levels.

The Department is a member of the Committee on Materials (COMAT) constituted to facilitate the inter-agency coordination of materials research. COMAT presently serves as a valuable forum

for the sharing of information in the fast-moving field of superconductivity. Thus, in my opinion, additional government-wide management structure beyond that already in place to plan, manage, and coordinate superconductivity research is not only unnecessary, but could even prove to be counterproductive. Redundant superstructures often have the effect of constraining innovation. In the present instance, the proposed assignment of the superconductivity planning function to the National Critical Materials Council would appear to be overtaken by events, for DoD has already developed a plan which is being coordinated through COMAT.

With respect to commercial implications of superconductivity, the Department recognizes that the utilization of federal R&D by the private sector is imperative in this era of growing competition in world markets. The combination of DoD's mission needs and historically close working relationships with industry and university researchers, facilitates the transfer of technologies (such as superconductivity) to the commercial sector. The President's superconductivity initiative will further strengthen the competitiveness of these industries.

In summation, the national security implications of high temperature superconductivity appear to be highly significant, and are being addressed by the Department within the framework of a comprehensive plan which mobilizes the nations' science and engineering resources, and embodies a high degree of collaboration

with relevant segments of the technical community. I am confident that superconductivity advances generated with DoD support will not only serve national security, but will be expeditiously transferred to the private sector for commercial exploitation as well.

I appreciate the opportunity to appear before the Joint Subcommittees, and shall be happy to respond to any questions you may have.